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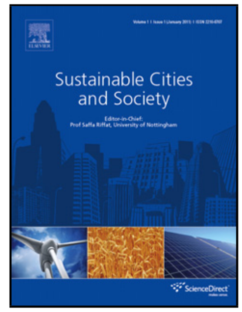

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Towards environmental sustainability adoption in construction firms: An empirical analysis of market orientation and organizational innovativeness impacts

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Highlights

(1) The main goal of this research was to explore the relationship between the organisational innovativeness factors market orientation culture and environmental sustainability adoption. However, research gap was overlooked in the introduction, and should be added as which provide overall research status on this research questions.

Response: This has been incorporated in the second paragraph in the introduction.

(2) What is the value of the research question? Namely, the importance of this research question should also be highlighted in the introduction.

Response: The value of this research question has been highlighted in the last paragraph of the introduction

(3) What is the result of pilot studies?

Response: The result of the pilot studies has been added to the Data collection and sample section.

(4) As mentioned by reviewer 2, many researches have been conducted on this topic, and more literature should be added. Meanwhile, the results of empirical study should be discussed by comparing to literature in order to find the difference, which might demonstrate unique value of this research.

Response: Comparison of the outcome of this study with other studies has already been done in the discussion section.

ABSTRACT

The contributions of the construction industry to the Greenhouse gas emissions due to non-renewable resource consumption have been generating discussions among stakeholders lately. Although the industry has been supporting lives both in urban spaces as well as in the suburban regions, the construction firms' resource consumption is detrimental to a sustained human environment. This paper empirically explores the organisational innovativeness factors and market orientation culture that could influence environmental sustainability adoption by Malaysian large construction firms. Both mail and personally-administered close-ended structured copies of questionnaire survey were employed to collect data from these construction firms. Partial Least Squares- Structural Equation Modeling technique was used to analyse 172 responses. The results indicated that market orientation and firm process innovativeness are capable of influencing the construction firms' environmental sustainability adoption. This implies that this study's model is a robust tool to predict the adoption of environmental sustainability by the construction companies. Although the findings of this study can be used to develop strategies to increase the rate of environmental sustainability adoption among the construction companies, it did not consider other relevant factors that could possibly and significantly explain the variance in environmental sustainability. Implications for research and practice and future recommendations were also discussed.

KEYWORDS: Construction firms; Environmental sustainability; firm product innovativeness; firm process innovativeness; market orientation

INTRODUCTION

The construction industry's immense contribution to the Greenhouse gas emissions due to non-renewable resource consumption have been generating series of discussions lately. While the industry has been supporting lives in urban spaces as well as in the peripherals, the resources consumed in the extraction, manufacturing, transportation, and the installation of construction materials are huge (Yeo & Potra, 2013). Aside the air, noise and waste pollution generated by construction processes and the existing building stocks, fossil fuels and minerals extraction use crude processes that are capable of changing the land ecological characteristics. In spite of the fact that the need for environmental sustainability (ES) within the construction industry has been recognized for several years, the construction sector is still taking the lead in energy consumption (Wong & Zhou, 2015). An approximately 10% of the global energy consumption goes to building materials manufacturing. Construction and demolition contributes about 40% of the solid waste generated in the developed nations, while operation stage of construction products emits almost 40% of the entire global Greenhouse gas emissions (Rode, Burdett, & Soares Gonçalves, 2011).

Thus, with the anxiety surrounding the extinction of non-renewable resources and the ever-increasing cost of energy, it is important to regulate the construction industry's energy consumption. Attention has been directed to 'going green' and ES assessment in construction in recent years (Wong & Zhou, 2015; Zuo & Zhao, 2014), whereas, studies conducted up to date on ES in construction mostly focus on building evaluation, using environmental impacts from construction stage to occupation and maintenance down to demolition. The studies also include upstream extraction of resources to the downstream end-of-life processes. Within construction, these assessments were done using several environmental assessment tools like the Leadership in Energy and Environmental Design (LEED), the Building Research Establishment Environmental Assessment Method (BREEAM), and the German Sustainable Building Council (DGNB) (Marsh, 2016). However, more recent studies like Wong and Zhou (2015) preferred research direction to move towards a comprehensive Building Information Modelling (BIM) for environmental sustainability over a building's full life cycle, and suggested that for newly developed and retrofitting projects, environmental assessment tools should necessarily incorporate the three R's concept (reduce, reuse and recycle) in their sustainability analysis. Likewise, Srinivasan, Ingwersen, Trucco, Ries, and Campbell (2014) also made a systematic comparison of energy-based building assessment tools and revealed major challenges confronting built environment stakeholders in building evaluation using

Life Cycle Assessment (LCA). These submissions, among others, imply that environmental assessment tools are not all-encompassing. And as such, ES assessment within the built environment requires firm specific contextualization that will be beneficial to both the construction firms and the environment. In view of this, the present study contributes to the existing body of knowledge by offering empirical support on the roles of firm innovativeness and market culture in mitigating the environmental impacts of construction.

With clients' satisfaction gaining prominence nowadays, several firms consider market culture to be a strategic imperative in today's competitive market environment, and they are advancing towards a more environmental sustainable construction through a range of policies and initiatives (Ogunbiyi, Goulding, & Oladapo, 2014).Considering the importance of clients' satisfaction, shareholders and investors' anticipations, market competition, and government policies as drivers of construction project delivery, the construction firms are increasingly incorporating ES into construction project execution to improve the construction industry's overall performance. This is important because the construction industry's activities has been threatening community health and safety through uncontrolled emissions, excessive waste generation and discharges for a long time (Sabnis, 2015).

In the wake of the importance of ES in construction, the Malaysian government recently introduced the National Corporate Green House Gas (GHG) Reporting Programme also known as MyCarbon. This introduction was in pursuance of the country's pledge at the 2009 United Nations Summit on Climate Change in Copenhagen to initiate GHG reduction actions (Yusof, Iranmanesh, & Waziri, 2016). These actions therefore led to the prioritization of environmental sustainability by the Malaysian Construction Industry (MCI), particularly by the Construction Industry Development Board (CIDB). According to Yusof et al. (2016), this awareness also prompted the launch of Bursa Malaysia's Business Sustainability Programme for corporate Malaysia, an index which requires all public listed companies in Malaysia to compulsorily integrate environmental, social and corporate governance criteria in their operations. However, in the process of incorporating ES concept, the importance of construction firms' innovativeness has also been highlighted in order to attain clients' satisfaction and needs, while also improving their competitive advantage (Green, Toms, & Clark, 2015).

Construction innovativeness is a major requirement of the firms within the construction industry to develop and implement new ideas that have both practical and commercial benefits (Dulaimi, Nepal, & Park, 2005). Construction firm's innovativeness is a significant introduction of new processes, products or management approaches, which is expected to increase organisational efficiency. Thus, this study intends to demonstrate the antecedent role of organizational innovativeness (product and process), as well as market culture on environmental sustainability among the construction firms in Malaysia. The value of this study lies in the effort to empirically describe how specific indicators of innovativeness in construction processes and products, as well as customer centred cultural orientation will assist construction firms to adopt ES in construction projects. In the subsequent sections, a review of the readiness for change theory is presented. Then, the relevant literature related to ES (the criterion variable) is discussed. Next, the predictors (firm product innovativeness, firm process innovativeness and market orientation) are discussed alongside their relationships with ES. This is followed by the measurement model specification (convergent validity, discriminant validity) and the hypotheses testing in the structural model.

READINESS FOR CHANGE THEORY

The study of change and development is a well-researched theme in construction management (Khosrowshahi & Arayici, 2012; Pettigrew, Woodman, & Cameron, 2001). According to Armenakis, Harris, and Mossholder (1993) readiness for change is a "cognitive precursor to the behaviours of either resistance to, or support for, a change effort" (p.681). And organisational readiness for change, in Weiner (2009)'s view, is a multifaceted construct with two dimensions. These are change commitment and change efficacy. While change commitment is a reflection of organisational employees' shared determination to implement the proposed change, change efficacy, on the other hand, explains employees' shared belief in their collective capacity to implement a proposed change (Weiner, Lewis, & Linnan, 2009).

From the extant literature, organisational readiness for change is conceptualized as a multi-level construct (Shea, Jacobs, Esserman, Bruce, & Weiner, 2014). However, the focus here is on one set of the behaviours that is organization-specific, as that would allow us to achieve parsimony in concept development and measurement. This dimension is preferred, especially considering the position of Weiner et al. (2009) that when an organisation exhibits high readiness for change, members are more likely to effectively initiate the change agenda, practices and procedures that are needed to support innovation. Therefore, firms' innovativeness in product and process, for instance, establishes their competitive dominance, and also grant new firms a strong leverage within the industry (Craig, Dibrell, & Garrett, 2014). Moreover a better understanding of organisational readiness for change contributes to firms' proper implementation and/or development of new ideas (Panuwatwanich & Stewart, 2012).

In this study, readiness for change is explained to mean the extent to which a construction organization exhibits readiness to adopt ES initiatives in construction project delivery. This orientation is manifested through centrality of environmental sustainability indicators to their construction business strategy, and the extent to which this becomes integrated in their identity (Tata & Prasad, 2015). Organizations differ in the extent to which they have developed systems to deal with environmental and social issues and have established technologies to use in implementing sustainability. Notably, ES is a change initiative involving all players within construction organisations at every level of the project execution to be willing to change from traditional construction practices to the adoption of environmental friendly construction practices (Adjarko, Osei-Poku, & Ayarkwa, 2014).

ENVIRONMENTAL SUSTAINABILITY

Rapid urban growth in developing nations has become a very important avenue for over-consumption of energy (Sadorsky, 2013). As this phenomenon continually stretches the environment beyond its limits, nations are facing the dilemma of delivering housing and infrastructure that could meet the population's social needs in an ecologically responsible manner (Chang, Ries, & Wang, 2010). Environmental activists have been stressing the need for an ideal society, where people live peacefully without necessarily depleting natural resources or degrading the natural environment, such that they leave man-made and environmental assets behind them in almost equal amount as they inherited from their earlier generations. However, such a scenario sounds more utopian than real in the construction world, as the construction industry is not only one of the resource-intensive industries, but also tends to destroy the ability to sustain the environment (Zhao, 2011). The aim of ES, therefore, is to reduce impacts and make the construction activities more sustainable. With institutional pressures to satisfy the environmental requirements of stakeholders, construction firms are being forced to evaluate their environmental impact and develop sustainable development indicators in order to reduce wastes (R. H. Chen, Lin, & Tseng, 2015; Zuo, Zillante, Wilson, Davidson, & Pullen, 2012). Eight different issues have also been identified under ES (as shown in Figure 1) that require construction industry to continuously add maximum value to construction end-products, while also minimising resource consumption, with minimum pollution considerations (Bjørn & Hauschild, 2013). A reduced resource consumption is possible through effective environmental planning, management and control, and they are capable of identifying the environmental risk and prevent water, ground and air pollution (Nahmens & Ikuma, 2011).

In the long run, a design that is environmental-friendly will realize the ES goals by encouraging a healthy and safe interior atmosphere, energy efficiency, the use of ecological benign materials, as well as eco-conscientious communities (Darwish, 2014). The construction activities consume large amount of certain constituents of the earth's non-renewable resources, especially the generic resources, which include energy, water, land and materials (Kibert, 2016; Tan, Shen, & Yao, 2011; Yuan, 2013), the usage of which results in changes to ecological structure of the biosphere. Having realised that the construction industry requires inputs from the earth's resources in order to maintain the built environment, it becomes important for the construction stakeholders to consider ES (Figure 1) as a vital management principle to attain reduction, reuse and recycling of the non-renewable resources (Sev, 2009).

Figure 1. Strategies for achieving ES in Construction. Adapted from Sev (2009)

FIRM PRODUCT INNOVATIVENESS AND ENVIRONMENTAL SUSTAINABILITY RELATIONSHIP

Product innovativeness contributes to organisational growth and competitive advantage. The concept is becoming unavoidable in recent times, as firms are beginning to rely on innovativeness in production for competitive advantage (Damanpour, 2010; Wilden & Gudergan, 2015). Thus, customers' demand for new products or executives' desire to penetrate new markets are some of the rationale behind product innovativeness. According to Hilmi, Ramayah, Mustapha, and Pawanchik (2010) and Wang and Ahmed (2004), firm product innovativeness refers to the uniqueness of new products that is being introduced to clients in an appropriate period. The concept is important for several reasons. Aside the fact that it presents greater opportunities for firms in terms of growth and expansion into new areas, substantial innovativeness in production could also establish firm's competitive dominant positions, while giving new firms a strong leverage within the industry (Danneels & Kleinschmidt, 2001).

Although the construction industry has been noted for its contribution to the economic development in many nations, especially as growth stimulant and employment generator, the industry has always been criticized for its lack of innovative techniques and excessive inefficiency when compared with other industries (Kamal, Kong-Seng, & Iranmanesh, 2014). It is therefore important that construction firms adopt innovative strategies to demonstrate their concerns for environmental protection. In view of this, firms in recent years are directing their efforts towards implementing proactive innovativeness in construction delivery that is meant to mitigate the impacts of their activities on the environment (Qi, Shen, Zeng, & Jorge, 2010).

Other studies have also noted that offering innovative construction products and materials to users helps in attaining environmental sustainability agenda, as firms' innovative technologies spur the delivery of ecologically friendly and healthy construction end-products (Shari & Soebarto, 2014). Firm's ability to innovate early in construction products is key to flexibility of construction type adaptable to users' changing needs, usage of fewer materials energy during material transportation and actual on-site construction, including functionality of construction components (P.-H. Chen, Ong, & Hsu, 2016; Dammann & Elle, 2006). In justifying these empirical evidences, this study investigates the innovative capabilities of Malaysian construction firms in production techniques as a driver for the adoption of ES. Hence, this hypothesis is advanced:

Hypothesis 1: Firm product innovativeness will significantly influence ES.

FIRM PROCESS INNOVATIVENESS AND ENVIRONMENTAL SUSTAINABILITY RELATIONSHIP

Innovation management literature has extensively reported the positive relationship between process innovativeness and environmental performance. In recent time, attention has been directed to the synergies existing in processes like lean techniques, Total Quality Management (TQM) and environmental protection (Hajmohammad, Vachon, Klassen, & Gavronski, 2013; Martínez-Jurado & Moyano-Fuentes, 2014; Wiengarten & Pagell, 2012). Firm's innovative processes like lean construction notably utilizes lesser construction materials, energy, and pollution cost from the acquisition to the completion stage of construction (Ogunbiyi et al., 2014; Piercy & Rich, 2015). Furthermore, as noted by Rodriguez and Wiengarten (2017), innovative construction practices facilitate the adoption of environmental sustainability because one of the main reasons for such practice is to reduce the marginal cost of pollution prevention, and improvement of environmental quality, user's health and safety through the development of improved capabilities, and increasing employee readiness about the changes in the construction process. Therefore once the employees are properly sensitized, teaching them additional skills may require less investment (King & Lenox, 2001).

Construction process innovativeness also allows firms to meet the market objectives in different perspectives, as it requires them to better understand clients' needs, and minimize defects in construction project processes (Kemp & Pontoglio, 2011). However, readiness of the construction firms and their understanding of the local needs and requirements are essential. Introducing innovative construction processes and methods will require adaptability to local needs and conditions in order to improve the old and traditional conditions. Process innovation should be evolutionary, and its adoption should not be assumed to abruptly replace the existing construction materials and methods with new and more efficient processes. Studies have shown that sudden changes of the current construction potentials, especially in the developing countries, may result in outright failure of an innovation (Hashemi, Cruickshank, & Cheshmehzangi, 2015). In this study, firm process innovativeness refers to the propensity and capability of Malaysian contractors to be innovative in their construction processes in order to deliver ES and attain a competitive edge within the industry. The antecedent role of firm process innovativeness in the adoption of ES has not been previously established within the Malaysian construction industry. In view of the above discussion, this hypothesis is advanced:

Hypothesis 2: Firm process innovativeness will significantly influence ES.

MARKET ORIENTATION AND ENVIRONMENTAL SUSTAINABILITY RELATIONSHIP

Market orientation culture emphasizes the implementation of marketing strategies that prioritize customer satisfaction more than other competitors. Firms with this culture believe that customer's satisfaction is the most effective way to achieve firms' objectives (Crittenden, Crittenden, Ferrell, Ferrell, & Pinney, 2011). Research has however suggested that ES is one of the main concerns of 21st century marketers owing to the fact that marketing approaches and the natural environment that sustains all life are closely linked. In this way, companies around the globe are under obligations to reduce their resource consumption, avoid natural environment destruction, prioritize consumers' demand for environmental friendly products, and be proactive in managing their business processes in order to protect both the natural and the built environment (Crittenden et al., 2011; Green et al., 2015). Market oriented firms are well-equipped in recognizing the changes in their customers' choices towards environmental protection and thus, act quickly towards implementing environmental sustainability agenda. The demand for eco-friendly construction products, according to Xia, Chen, and Zheng (2015) is becoming one of the most important factors driving environmental sustainability adoption among firms. Market oriented firms also promote penetrating the market with innovative products and services over old and unsustainable ones. Such organisation assesses market demands and the policies performance on a regular basis, yielding constant and improved ES (Green et al., 2015; Rehman & Shrivastava, 2011).

Results from the extant literature (Bos-Brouwers, 2010; Clark, Toms, & Green, 2014; Zhu & Sarkis, 2004; Zhu, Sarkis, & Lai, 2008) indicated a significant association between market orientation culture, green supply chain management, environmental performance and organisational performance. However, there has not been any empirical study within the domain of construction firms on the relationship between market orientation and ES. Hence, this study intend to establish this relationship by advancing another hypothesis as follows:

Hypothesis 3: Market orientation will significantly influence ES.

Figure 2: Conceptual model

Based on the existing literature, our conceptual model is depicted in Figure 2. ES is the endogenous latent variable, while firm product innovativeness, firm process innovativeness and market orientation are the exogenous latent variables. In addition, the conceptual model shows that the predictors influence construction companies' ES, after controlling for their staff strength and company age.

RESEARCH METHODOLOGY

Data collection and sample

In order to have a deeper understanding of the phenomenon in this study, primary data collection was focused on. However, before the actual data collection for this study, a pilot study was conducted where a total of forty-five (45) copies of questionnaire were personally administered to Malaysian large construction firms in June, 2015. Based on the suggestions of (Malhotra, Hall, Shaw, & Oppenheim, 2004) that pilot studies sample size should be relatively smaller, ranging from 30 to 100 respondents, forty-five (45) copies of questionnaire are justified for the purpose of determining the internal consistency of this study's variables. And a five-point likert scale interpretation was used in measuring all the variables, anchored by 1 = not at all, to 5 = completely true. In the pilot study, the responses from the construction firms were used to measure the internal consistency reliability for each of the variables with the aid of Cronbach's alpha coefficient. The result indicated that the internal consistency reliability for all the variables ranged from 0.889 to 0.958, indicating high reliability of all the scales (Sekaran & Bougie, 2011). After this pre-test, the questionnaire was refined to produce the final version. Main data collection was conducted using mail and personally-administered survey methods with the aid of close-ended structured questionnaire. The mailed survey method was extensively used in this study because it allows the researcher to cover a wider geographical area and eliminate interviewers' bias. Based on Krejcie and Morgan (1970) generalized sample size parameters, a sample size of 354 is required for a population of 4520 construction firms (population of construction firms sampled from the Construction Industry Development Board directory). According to Waris, Liew, Khamidi, and Idrus (2014) studies, the Malaysian construction industry has always been associated with low response rate. In order to deal with this phenomenon, the recommendation of Hair, Wolfinbarger, Ortinau, and Bush (2008), that the sample size could be doubled, is considered in this study. Thus, 708 copies of questionnaire were administered, and a total of 172 copies of were retained for analysis as against the entire 189 total responses. Invalid and incomplete responses were responsible for the exclusion of 9 responses. While another 8 cases were removed after the assessment of multivariate outlier, which gives a 24 per cent response rate. The response rate is adequate considering Akintoye (2000) and Dulaimi, Ling, and Bajracharya (2003) who argued that survey response for the construction industry is usually within the range of 20–30 per cent. Hence, the response rate in this study is justified.

Measures

Firm product innovativeness was measured using Kamaruddeen, Yusof, and Said (2010)'s five-item scale. Respondents were asked to indicate their opinion on a 5-point scale anchored by "5" (not at all) and "1" (completely true) to measure their company's level of product innovativeness in construction project execution on such items like "We tend to be an early adopter of innovative construction process or practice in our company". We also used Kamaruddeen et al. (2010)'s four-item scale to measure firm process innovativeness, where responses were given on five-point likert scale, ranging from "1" (completely true) to "5" (not at all).

As regards market orientation, the 9-item scale of Jaworski and Kohli (1993) was used to generate responses from the construction companies' representatives. Respondents were asked to indicate their responses on a 5-point scale ranging from "1" (completely true) to "5" (not at all). A sample of item was "Our competitive advantage is based on understanding clients' needs".

Assessment of ES adoption was based on 5-point multi-item rating scales adapted from Abidin (2005). Respondents were asked to rate their companies' ES compliance using an 8-item scale, which include items like "Waste minimization is an important sustainable construction consideration in our projects".

Control Variables

In order to ensure that the relationships between the predictors and the criterion variable (ES adoption) are not confounded, the demographic variables of company age (continuous variable), and staff strength, were controlled.

ANALYSIS AND RESULTS

To reduce the effects of common method variance (CMV), certain procedures were carried out in this study, based on the suggestion of Podsakoff, MacKenzie, and Podsakoff (2012) and Podsakoff and Organ (1986). Firstly, evaluation apprehension was reduced by giving prior information to the respondents that there is no right or wrong response, and they were also assured that their responses will be treated with utmost confidentiality throughout the research. Secondly, vague and inexplicit wordings were absolutely avoided in the draft questionnaire. Lastly, scale items were further improved by ensuring that the wordings of the questions in the survey instrument were written in a simple English language that can be easily understood by the respondents. Specifically, Harman's single factor test was carried out to further examine common method variance. This procedure involves entering all variables into exploratory factor analysis (EFA), with the aid of unrotated principal components factor analysis. This is done in order to determine the particular number of factors that are required to account for the variance in the variables.

Other assumptions like linearity, normality, and multi-collinearity were checked (Hair, Black, Babin, Anderson, & Tatham, 2010). Once these assumptions have been satisfied, Partial Least Square (PLS) path modeling with the aid of SmartPLS 2.0 software was used to test the theoretical model in this study. The PLS path modeling is considered the most suitable technique in this study for several reasons. First, PLS path modeling has the advantage of estimating the relationships between constructs (in structural model) and the relationships between indicators and their corresponding latent constructs (in measurement model) simultaneously (Duarte & Raposo, 2010; Lohmoeller, 1989). Second, PLS path modeling is considered ideal because the study aimed to predict organizational deviance, which is the endogenous latent variable (Fornell & Bookstein, 1982; Hair, Ringle, & Sarstedt, 2011). Third, PLS path modeling has been established as a useful and preferred multivariate analysis technique in social and psychological research, such as in accounting, management, marketing, information systems, and operations management (Hair et al., 2011; Hulland, 1999).

The respondents were those in the managerial positions in the construction firms. They include project managers, general engineers, quantity surveyors, executive directors, contract managers, construction managers, marketing managers and others. Table 1 shows the survey distribution between various groups of respondents.

Table 1: Distribution between various groups of respondents

MEASUREMENT MODEL ESTIMATION

In order to assess the psychometric properties of this study's adopted scales, individual item reliability, internal consistency reliability, and discriminant validity were determined. Individual item reliability was assessed by examining the outer loadings of each construct's measure (Hair, Hult, Ringle, & Sarstedt, 2016). According to Barclay, Higgins, and Thompson (1995), the rule of thumb for retaining items states that loadings should be 0.50 and above. In view of this, none of the items in this study was deleted as all the items were loaded above the 0.50 threshold. Thus, in the whole model, all the 26 items were retained as they showed loadings between 0.713 and 0.885 (as shown in Table 2).

Table 2. Factor loadings and reliability

Furthermore, composite reliability coefficient was employed in determining the internal consistency reliability of the measures in this study. Researchers like Bagozzi and Yi (1988) and Hair et al. (2011) suggested that to determine a sound model, internal consistency using composite reliability coefficient should be more than 0.7. In Table 1, the composite reliability coefficients of the latent constructs ranged from 0.926 to 0.941. As each latent construct exceeded the minimum acceptable level of 0.70, the internal consistency reliability of the measures used in this study was considered adequate (Hair et al., 2011).

Equally, the Average Variance Extracted (AVE) test was also checked to assess internal consistency of the constructs (Fornell & Larcker, 1981). This was done by measuring the actual amount of variance that a latent construct captures from its measurement items relative to the amount of variance due to measurement errors. The basic assumption in this case is that the average covariance among indicators has to be positive. Researchers (Fornell & Larcker, 1981; Hair et al., 2011) argue that the AVE should be higher than 0.5., implying that at least 50 percent of the measurement variance is captured by the latent construct.

The last consideration in measurement model estimation for this study is the discriminant validity, which was ascertained using the square root of the (AVE) as suggested by Fornell and Larcker (1981). This was achieved by comparing the correlations among the latent constructs with square roots of AVE. In order to achieve this, Fornell and Larcker (1981) argued that the square root of the AVE should be greater than the correlations among latent constructs. As indicated in Table 3, where the correlations among the latent constructs were compared with the square root of the AVEs, it was clear that the square roots of the AVEs (appearing in bold) were all greater than the correlations among latent constructs. This suggests an adequate discriminant validity.

Table 3. Descriptive statistics and correlations among latent variables

STRUCTURAL MODEL RESULTS

To better predict, explain, and increase environmental sustainability among the Malaysian large construction companies, there is need to understand why some construction companies choose to improve their ES, while similar others operating within the same market conditions do not. In the structural model, measures such as path coefficients, which is an indication of the strengths of the relationships between the dependent and independent variables, as well as the R^2 value, which signifies the amount of variance explained by the independent variables, were used in assessing this study's model. Essentially, the R^2 value was a measure of the predictive power of the dependent variable in the model (Hair, Sarstedt, Ringle, & Mena, 2012). Thus, the path coefficients together with the variance explained (R^2) indicated how well the data supported this study's model.

The graphical representation of the structural model analysis results aimed at testing the hypothesized causal relationship among the latent variables is presented in Figure 2. The effects of company age and staff strength of the construction companies were also incorporated into the model. As shown in Figure 2, the numbers depicted along the arrows are the *t* values. Considering the fact that this study's hypotheses were stated in a directional form, the power of one-tailed test was opted for (Kimmel, 1957).

Figure 3. Resulting path coefficient with loadings, significance and R^2

Notes: Path coefficient with *t*-value in parentheses; *** significant at 0.01 (1 tailed)

In Hypothesis 1, it is predicted that firm product innovativeness will significantly influence ES adoption. Result in Table 4, and Figure 2 however revealed that there is no significant relationship between these variables regardless of company age and staff strength. This result is also an indication that data used in this study does not have sufficient power to detect the relationship in this instance. Thus, hypothesis 1 was not supported. In hypothesis 2, it was predicted that firm process innovativeness would significantly influence ES adoption regardless of company age and staff strength. As expected, the result indicated firm process innovativeness significantly influences ES adoption, regardless of company age and staff strength ($\beta = 0.217$, $p < .01$).

In examining the direct effects of market orientation on environmental sustainability (*H3*), the result indicated that market orientation showed a significant positive relationship with ES, regardless of company age and staff strength ($\beta = 0.572$, $p < .01$), suggesting support for hypothesis 3. The variance explained by the three independent variables was 0.517, after controlling for the demographic variables. This suggests that the three exogenous latent variables (i.e., firm product innovativeness, firm process innovativeness, and market orientation) collectively explained 51.7% of the variance in ES, after controlling for company age and staff strength. And going by the assumption of Hair et al. (2016), an R^2 value of 0.10 was regarded as the minimum acceptable level. Following this recommendation, it could be established that the endogenous latent variable in this study has an acceptable R^2 value.

Table 4. Results of hypothesis testing

DISCUSSION

The main objective of this study was to examine the influence of organisational innovativeness dimensions (product and process), and market orientation on ES among Malaysian large construction companies. Firstly, contrary to expectations, the results generated by hypothesis 1, that firm product innovativeness will significantly influence ES was not statistically significant. This lack of significance is worth discussing. A possible explanation for this non-significant relationship could be that data collected for this study does not have sufficient power to detect the dependence in this instance. Thus, the result in this study deviates from the findings of previous researchers in this field (De Medeiros, Ribeiro, & Cortimiglia, 2014). Secondly, it was conjectured that firm process innovativeness would have a significant positive relationship with ES adoption (*H2*). As expected, the findings revealed a significant positive relationship between firm process innovativeness and ES adoption. The implication of this is that the more innovativeness a company was able to implement in the construction process, the greater their level of ES adoption, as indicated in previous studies (Kemp & Pontoglio, 2011; Tseng, Chiu, Tan, & Siriban-Manalang, 2013; Zhu, Sarkis, & Lai, 2012). Thirdly, as regards hypothesis 3, market orientation showed a significant positive relationship with ES adoption. This finding suggests that firms with a strong sense of market orientation are able to develop and implement practices that support the delivery of eco-friendly products in line with their customers' demands for such products (Dulaimi et al., 2005). In a related study, Green Jr, Zelbst, Meacham, and Bhadauria (2012) equally asserted that United States firms are easily responsive to environmental protection demands of their clients because they are more market oriented.

CONCLUSION AND IMPLICATIONS

The major contribution of this study is to empirically explore the organisational innovativeness factors and market orientation culture influencing ES adoption by Malaysian large construction companies. The results from the PLS analysis showed that this study's model is indeed a robust tool for predicting the construction companies' environmental sustainability adoption, as the model provides the factors that influence the adoption of ES. These factors can be given more considerations by Malaysian Construction Industry to determine which construction company is complying with the environmental regulations of the Malaysian government. If these innovative factors and market orientation culture are given considerations by the construction companies, they will be more willing to adopt ES. The findings of this study can be used to develop strategies to increase the rate of environmental sustainability adoption among the construction companies.

The results of this current study have both theoretical and practical implications. The study has been able to provide a theoretical implication by giving additional empirical evidence within the domain of readiness for change theory (Khosrowshahi & Arayici, 2012; Pettigrew et al., 2001; Weiner, 2009), which originally posits that a broad-range approach is necessary to develop capacity that is useful for complex changes within an organisation. However, instead of focusing on the motivation and attributes of workers to create innovative processes as advocated in the original model, this study extends the theory by examining the influence of innovative capabilities of contractors on ES delivery in project execution. This is crucial because innovative construction technologies and products have been noted to reduce the ecological burden of construction projects. This situation will require the construction firms to change their technologies and better understand the fundamentals of ES adoption in construction project execution (Rohracher, 2001). Our results also indicate that market oriented construction firms are better in ES adoption. The results suggest that organizational cultural orientation that is customer centred will assist construction firms to adopt ES in construction projects. This is not unconnected to the fact that market oriented firms are always sensitive to their customer's satisfaction. Clients' demands for environmentally friendly construction practices and products have recorded an unprecedented growth in recent times, and this has assisted green construction markets output and competiveness (Ingrao et al., 2014).

There are few limitations of this study. Firstly, this study adopts a cross-sectional research design which, apart from the fact that the data collection technique is one-shot, single-point-in-time, it also precludes causal inferences to be made from the study's population. Thus, an alternative research design, a longitudinal design, is suggested for future research considerations. This will allow the measurement of the latent variables at different points in time to further confirm the findings in this study. Secondly, this study offers quite limited generalizability as only participants from large construction firms in Malaysia were relied on. We are aware of the fact that ES compliance is a requirement for all businesses at all level. Importantly, other previous studies have indicated that larger construction companies are only able to adopt ES due to government regulatory requirements (Sezer, 2015). Therefore, future researchers may wish to extend this study further to include construction SMEs and entrepreneurs who have also been shown to be more responsible towards environmental management within their organization's overall mission. Smaller firms are also more likely to get committed to changes in their construction products, processes and business initiatives that may be unsustainable (Sharma & Henriques, 2005). Thirdly, the lack of significant relationship between firm product innovativeness and ES could be influenced by introducing a moderating variable which could possibly contribute meaningfully to the relationship. Above all, future studies might examine how government policy could further strengthen this relationship, and also among different sizes of construction companies. For instance, previous researches have demonstrated that effective and comprehensive energy regulations and its enforcement play a vital role in reducing the impacts of construction on the environment (Chandel, Sharma, & Marwaha, 2016). Fourthly, organizational innovativeness is usually operationalized using a taxonomical approach with multidimensional clustering (Kilic, Ulusoy, Gunday, & Alpkan, 2015), whereas only two dimensions are considered in this study. Consequently, the results are limited to product and process innovative capabilities of construction firms. Future research should empirically investigate other dimensions of organizational innovativeness for a better representation of reality and to further reveal otherwise hidden firm's capabilities. While it is obvious that the predictive power (R^2 value) of this model is substantial, the common method variance (CMV) was addressed as suggested by Podsakoff et al. (2012), and several procedural remedies were used before data collection so as to prevent the occurrence of CMV. Specifically, Harman' single factor test was used to check for CMV, and the results indicate that CMV is not a serious issue in this study.

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Figure Captions

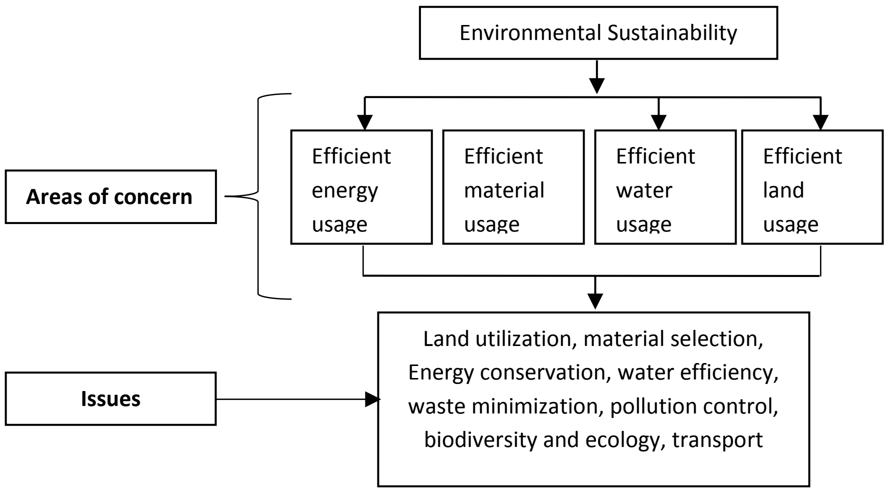

Figure 1. Strategies for achieving ES in Construction. (Adapted from Sev, 2009)

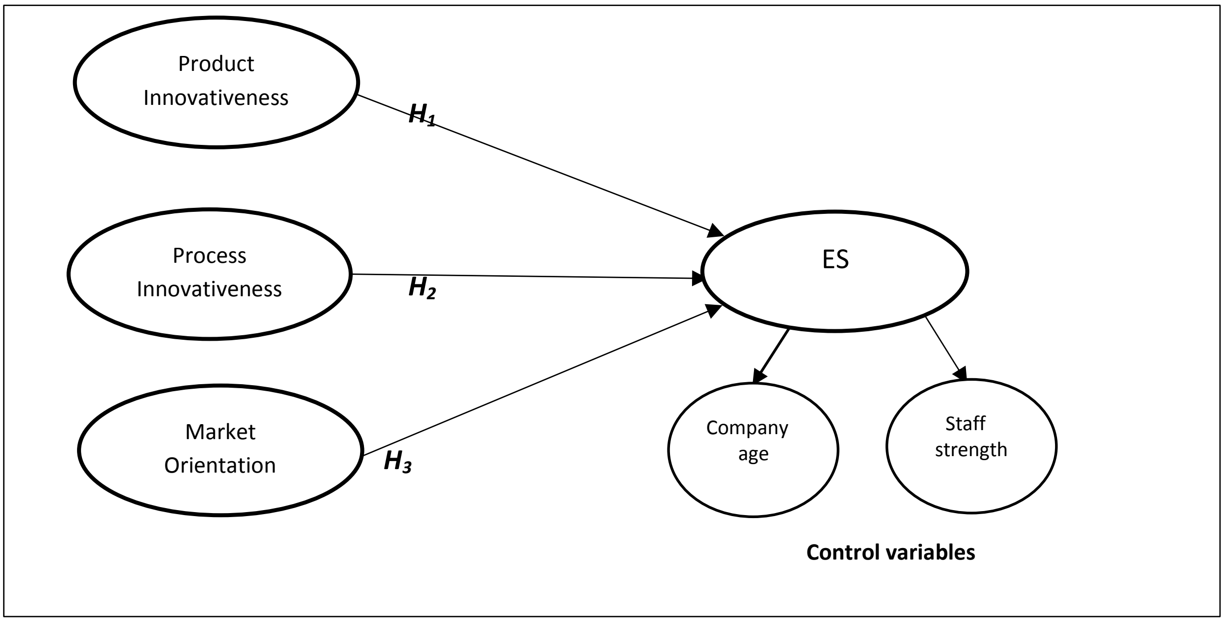

Figure 2: Conceptual model

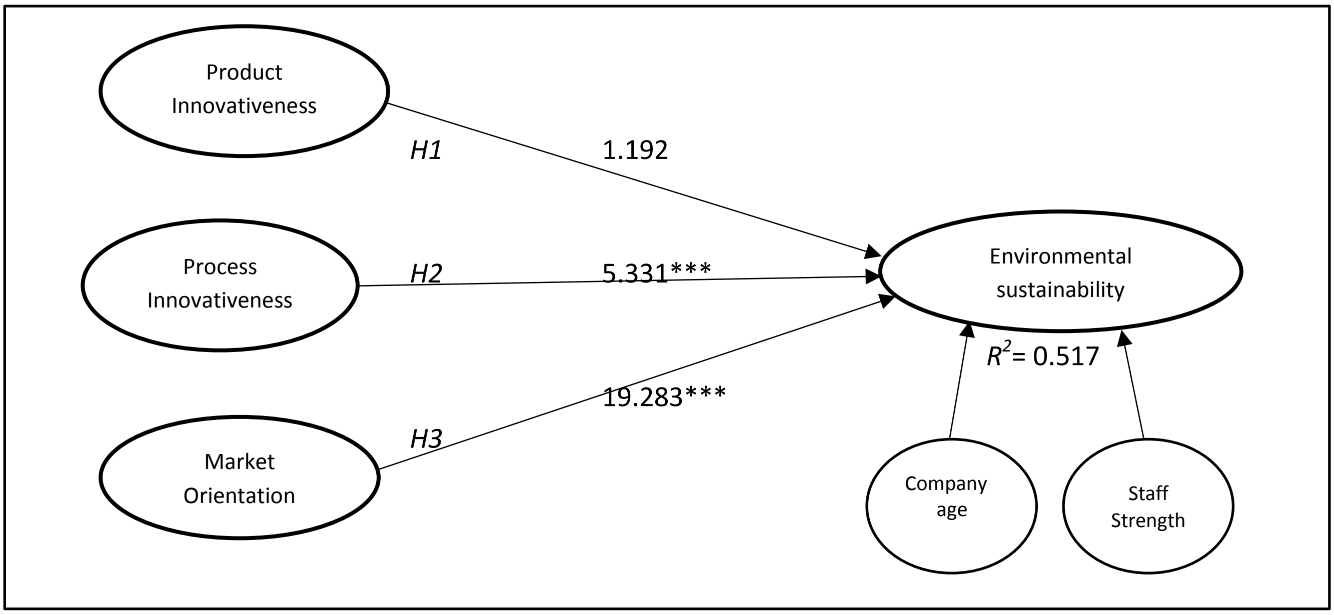

Figure 3. Resulting path coefficient with loadings, significance and *R^2*

Notes: Path coefficient with *t*-value in parentheses; *** significant at 0.01 (1 tailed).

Tables

Table 1. Distribution between various groups of respondents

Project managers	General engineers	Quantity surveyors	Executive directors	Contract managers	Construction managers	Marketing managers	Others
18.9%	16.7%	13.9%	13.3%	8.9%	7.2%	2.8%	18.3%

Latent variables	**Items**	**loadings**	**Composite Reliability**	**Average Variance Extracted**
Environmental Sustainability	Evt1: Location selection is an important sustainable construction consideration in our projects.	0.756	0.941	0.665
	Evt2: Material selection is an important sustainable construction consideration in our projects.	0.876		
	Evt3: Waste minimisation is an important sustainable construction consideration in our projects.	0.799		
	Evt4: Energy conservation is an important sustainable construction consideration in our projects.	0.828		
	Evt5: Water efficiency is an important sustainable construction consideration in our projects.	0.807		
	Evt6: Pollution control is an important sustainable construction consideration in our projects.	0.847		
	Evt7: Biodiversity protection is an important sustainable construction consideration in our projects.	0.856		
	Evt8: Heritage and amenity protection is an important sustainable construction consideration in our projects.	0.748		
Product Innovativeness	PRO1: We actively develop new construction products in-house in our company.	0.713	0.908	0.666
	PRO2: Our company sees creating new construction products as critical to our success.	0.857		
	PRO3: Our company tends to be an early adopter of innovative construction products or materials.	0.883		
	PRO4: Within our company, we are able to adopt innovative construction products or materials used by other companies.	0.834		
	PRO5: Our company seeks innovative construction products or materials from outside this organization.	0.783		
Process Innovativeness	PRC1: We tend to be an early adopter of innovative construction process or practice in our company.	0.869	0.926	0.757
	PRC2: We are able to implement innovative construction process used by other companies.	0.885		
	PRC3: We actively develop in-house solutions to improve our construction development process.	0.859		
	PRC4: We seek innovative construction process outside our company.	0.867		
Market Orientation	MKT1. We share competitor's information within the company.	0.733	0.940	0.634
	MKT 2. We respond rapidly to competitive actions in our company.	0.792		
	MKT 3. Top management in our company regularly discusses the strength of our competitors.	0.807		
	MKT 4. We always focus on clients in our company	0.796		

	whenever we have an opportunity for competitive advantage.	
	MKT 5. We pay close attention to post construction reviews in our company.	0.818
	MKT 6. Business objectives are driven by client's satisfaction in our company.	0.788
	MKT 7. Our competitive advantage is based on understanding clients' needs.	0.759
	MKT 8. In our company, we closely monitor and assess our level of commitment in meeting the needs of our clients.	0.812
	MKT 9. Business strategies are driven by the goal of increasing client's value in our company.	0.855

Table 2. Factor loadings and reliability

Table 3. Descriptive statistics and correlations among latent variables

Latent Variables		**1**	**2**	**3**	**4**
1.	Environmental Sustainability	**0.816**			
2.	Market Orientation	0.684	**0.796**		
3.	Process Innovativeness	0.525	0.489	**0.870**	
4.	Product Innovativeness	0.530	0.571	0.780	**0.816**

Table 4. Results of hypothesis testing

Variable	**Hypothesis**	**Path coefficient**	***t*-stats**	**Result**
Product Innovativeness	*H1*: Product innovativeness will significantly influence environmental sustainability.	0.041	1.192	Not supported
Process Innovativeness	*H2*: Process innovativeness will significantly influence environmental sustainability.	0.224	5.331***	Supported
Market Orientation	*H3*: Market orientation will significantly influence environmental sustainability.	0.552	19.283***	Supported